The Evolution Of Catchment Gullies In Studinet And Simila Watersheds, Eastern Romania, During The Last 25 Years

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1. Abstract

Classical gullies having leaf like catchments of more than 300 hectares (up to 579 ha) have a special impact on geomorphology in the area and, more importantly, on local social communities. A certain number of them have been approached in their entirety, taking into account the gully within its watershed in a systemic manner, and the information regarding vegetation cover, land use, morphometric parameters and geology has been updated in 2007. Data acquired during the field survey and specially the results of measurements made by ultimate RTK GPS equipment have been compared with information gathered from digitized topographical maps dating back in 1982.

The selected gullies are located in two watersheds, Studinet (9678 ha) and Simila (26521 ha), within Tutova Rolling Hills, Eastern Romania.

2. Materials and method

Topographical maps at the scale of 1:25,000 covering the two mentioned watersheds have been scanned and then georeferenced when being imported into GIS software. Further on, gullies of interest together with several items illustrating the landuse such as forests, different kinds of plantations (orchards, vineyards, etc.), or geography (communication networks, hydrography, localities, etc.) have been digitized on screen and analyzed by different GIS techniques. The digitized elevation lines allowed us to interpolate the digital terrain model.

Later on, by means of GPS professional equipment (Magellan Thales Z-Max.Net), information gathered during the early research stages has been updated.

The relief of the studied watersheds was divided in several physiographic regions (areas having similar geology, geomorphology, land use, climatic conditions, etc.) and that helped us identifying the factors that control the morphology and dynamics of gullies. The maximum elevation in Studinet watershed is 481.9m (Cheii Hill) and the lowest elevation is 108.91 m at the junction with Tutova river.

From the geological point of view we have noticed only the Neogene deposits belonging to Chersonian and Meotian which include sands, clays and marls, having thin calcareous or more rarely silica intercalations. These deposits seem to have a decisive role in morphology and dynamics of gullies.

Aspects regarding the mathematical modeling by taking into account the influence of local geology and land use are discussed and have been approached unlike the general trend in the literature.

3. Results

Several physiographic areas have been identified, as they were supposed to help us understanding the factors controlling the morphology and dynamics of gullies, such as:

- the easterly looking hillside of Studinet valley, ranging from the junction with Tutova river and Gherghesti commune, relatively short (700-800 m length) and uniform (not fragmented by small valleys, gullies or landslides), slopes of 10-40%, and having the upper third of the hillslope covered by forest and the lower third used as arable land or pasture;
- the floodplain of Studinet river;
- the left hillside of Studinet, 3-4 times longer than the right one, downhill from Gherghesti commune, fragmented by five important catchment gullies: Halaresti, Silistea, Recea, Lunca and Lupului Valley;
- the Upper Studinet, at the North from Gherghesti commune, dominated by several small contributors.

Within Studinet watershed, four catchment gullies have been surveyed:

a) Silistea micro watershed (Figure 1):

- catchment area 579.89 ha
- gullies effective area: in 1982 – 16.26 ha; in 2007 – 26.23 ha (+61%)
- gullies perimeter: in 1982 – 10.62 km; in 2007 – 17.48 km (+65%)

In Silistea micro watershed the effective area of gullies increased by 61%, and if the actual map is overlaid onto the map from 1982, one may notice that the catchment gully extended very little by headcut advance and mainly by bank processes and lateral landslides. It seems that, in this case, the great percentage of forests coverage (>50% of watershed area) had little or no significant effect on extension process.

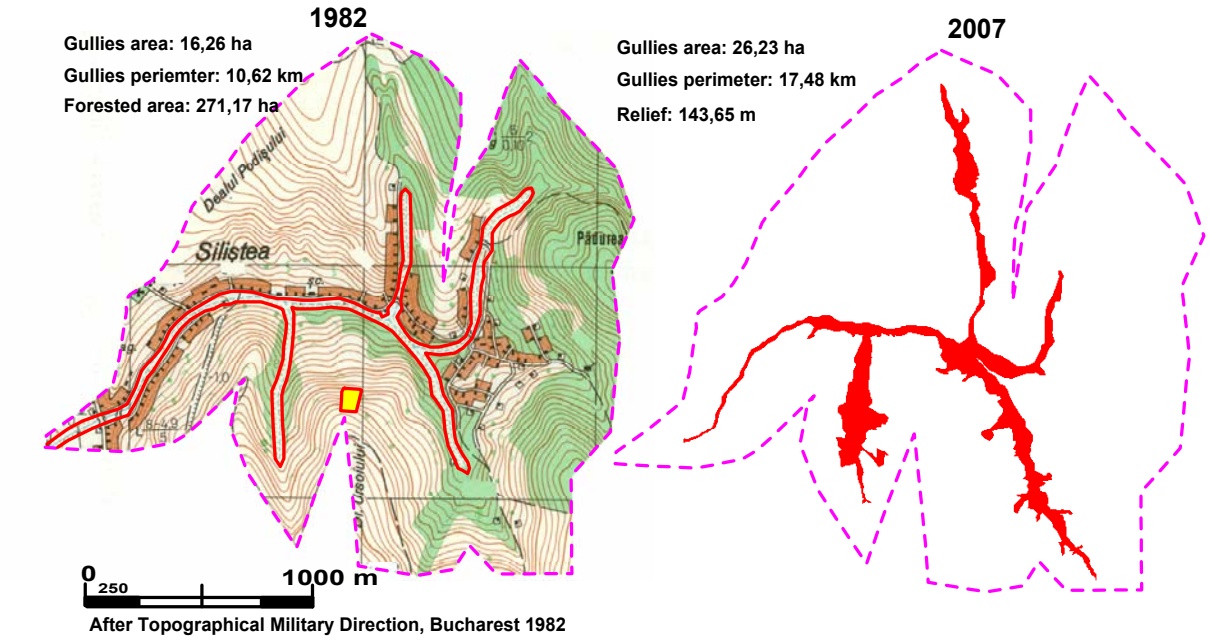

Figure 1 Silistea catchment gully in 1982 and 2007

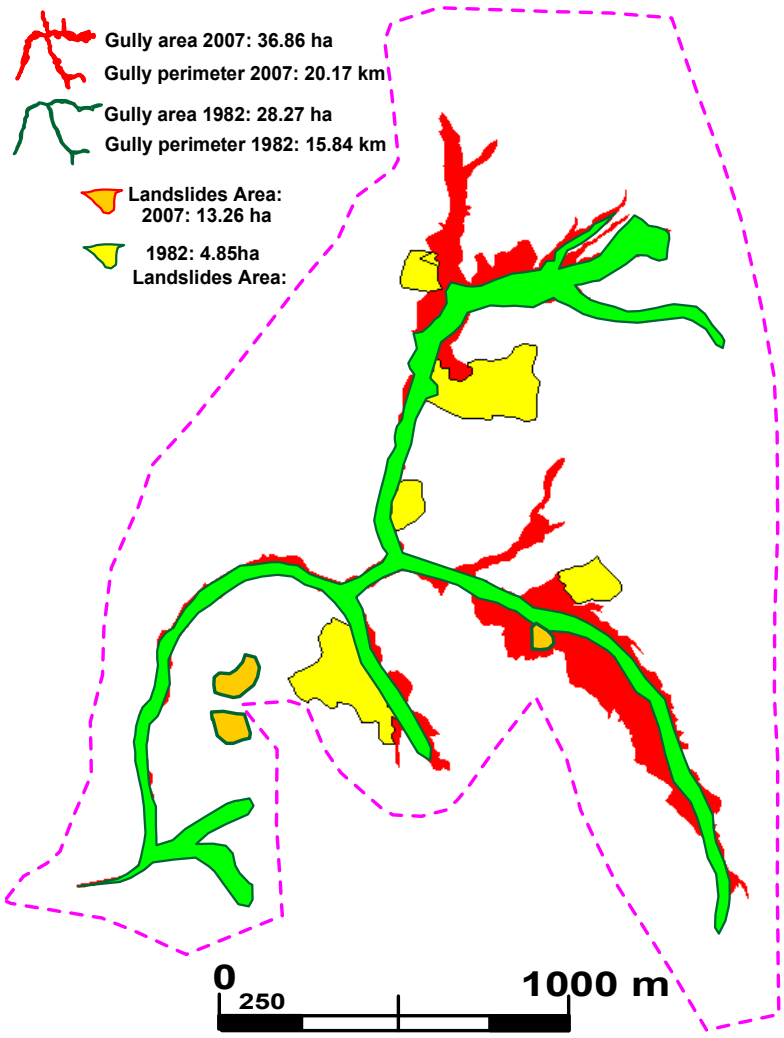

Figure 2 Lunca catchment gully in 1982 and 2007

b)Recea micro watershed

Recea gully catchment is the smallest of all studied in 2007. The perimeter and area of this gully has undergone insignificant modifications during the last 25 years, probably because of vegetation cover (grasses). Only one small landslide was inventoried.

c) Lunca catchment gully (Figure 2)

In this micro watershed the evolution of both gullies and adjacent landslides was dramatic. There is a eloquent example of a gully which was not influenced at all by the remaining catchment, uphill from the active headcut. The channel of the gully itself became many years ago catchment and the extension process took place almost exclusively by bank processes and lateral landslides. The percentages of variation illustrating the differences between some morphometric variables in 1982 and 2007 are significant: the effective area of the gully (+23%), gullies perimeter (+21%), lateral landslides area (+63%). Concomitantly, the forested area remained unchanged, plantations area (orchards and/or vineyards) decreased by 40%, and localities area decreased by 1%.

d) Lupului Valley micro watershed (Figure 3)

This catchment gully has the same degree of complexity as the previous (Lunca) and had an evolution some how similar. However, there are two big differences between the two:

- even though Lupului Valley is one of the biggest catchment gullies, it is one of the least populated,
- the forested area is only 3.5% of the total area of Lupului watershed.

The percentages of variation illustrating the differences between some morphometric variables in 1982 and 2007 are: the effective area of the gully (+16%), gullies perimeter (+20%), lateral landslides area (+90%). This last percent of lateral landslides variation might seem to be very big, but practically it means only 7 hectares.

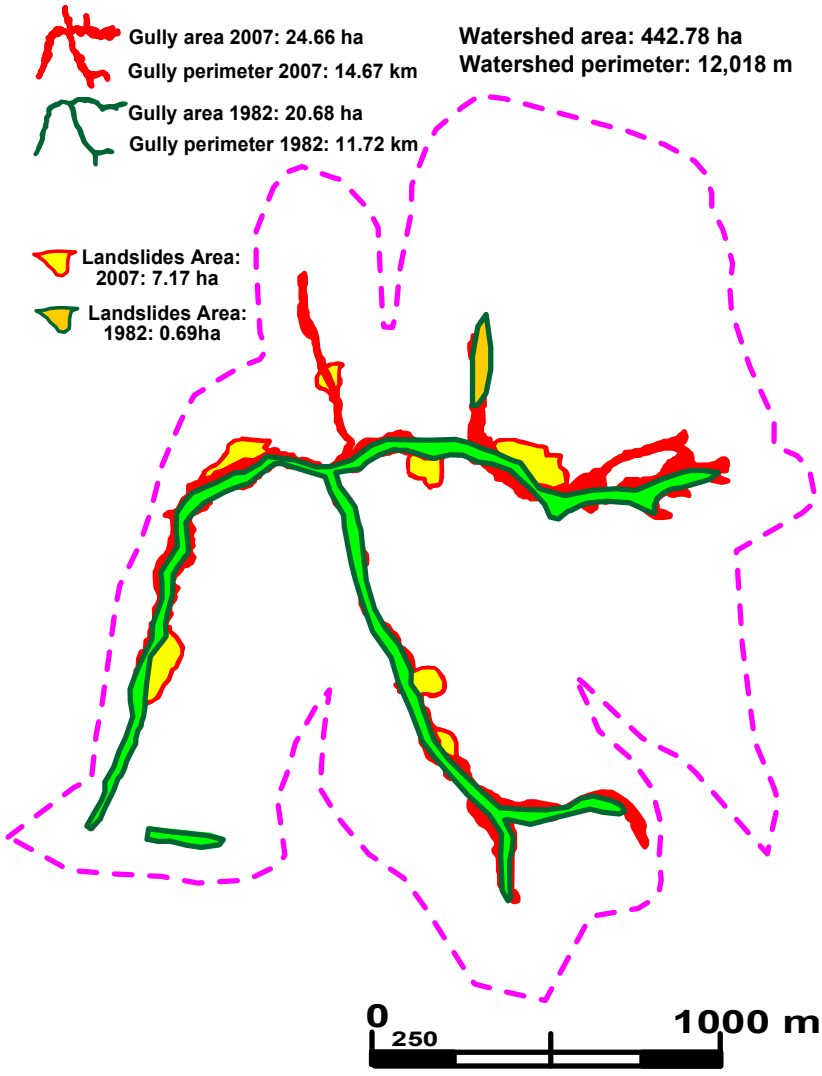

Figure 3 Gullies and landslides in Valea Lupului catchment, Studinet watershed.

Simila watershed is three times greater than Studinet and much more complex. A number of 122 gullies were inventoried, but among them, only four were selected as being representative for what we name catchment gullies. The rest of them are either valley bottom gullies or, in places, valley side gullies. From the catchment gullies identified, some are heavily forested, so that only four of them were selected as being spectacular and likely to be included in this survey. The catchment gullies surveyed by GPS equipment are: „Al. Vlahuta" – Monastery, Cepesti – Gura Odaii, Cepesti – Rapa Mocanului, and the very interesting Tunsesti no. 1 North.

4. Conclusions

- Studinet watershed has a great coverage of forestall vegetation (>30%), and forested areas did not have undergone significant changes. The plantations area decreased drastically (by 40%);
- The relief is dominated by valley bottom gullies, valley side gullies and five catchment gullies. That is why the arable land is insufficient and local people learned to live with gullies;
- The geological structure dominated by sandy loam deposits with thin calcareous sandstone or clay intercalations determined a great depth/width ratio (2.43) of gullies. The presence of loessial deposits and of clay lenses influenced the overall extension process by bank failure (slab failure) and lateral landslides;
- The channels of the gullies became rain collectors (catchments) themselves many years ago and that is why they definitely must be taken into account when modeling the future evolution, together with the remaining catchment uphill from the active headcuts. The channels are very well forested so that very few headcuts are still active;
- The effective area of gully channels increased by 23 - 63% during the last 25 years, (an average rhythm of 0.25 ha/year; this figure means very little, while the headcuts advance does not take place continuously);
- Simila watershed is three times greater than Studinet and much more complex. A number of 122 gullies were inventoried by GIS techniques and field trips, but only four of them were surveyed by GPS equipment as being illustrative catchment gullies;
- In Simila watershed, in spite of the great number of gullies and landslides inventoried both in 1982 and in 2007, very few of them have undergone significant evolution during this period, and that is due to the efficiency of antierosional practices (mainly forestation of the gully channel). The ultimate illustration of that efficiency is the very low siltation ratio of Rapa Albastra reservoir, which was supposed to collect a large amount of alluvium coming from upland;
- The professional GPS equipment proved to be a very useful surveying tool because of its accuracy and productivity, while the gully channels are almost always heavy forested, so that there is no line of sight.

5. References

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